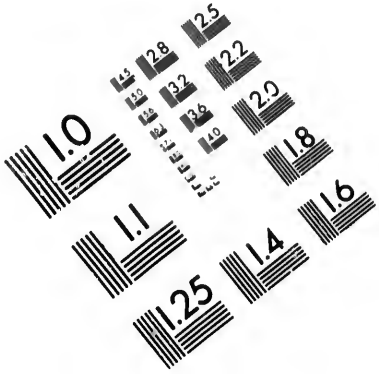

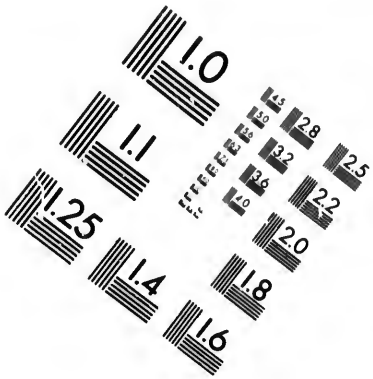

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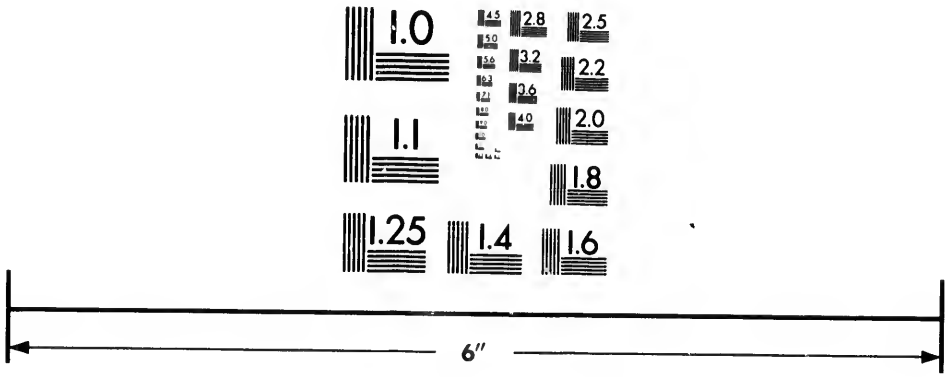

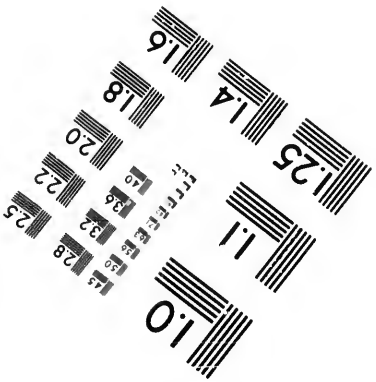

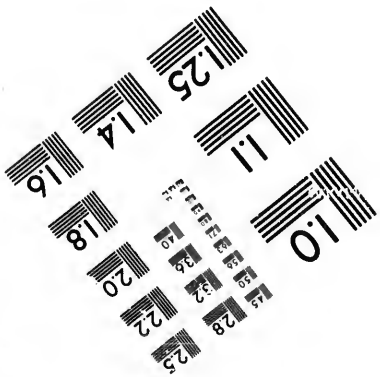

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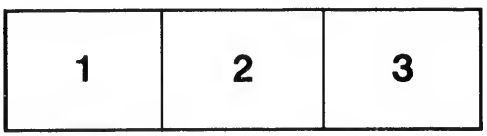

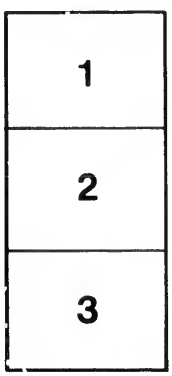

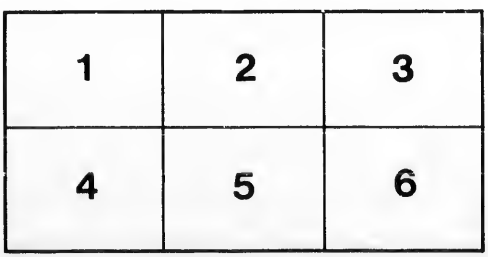

CHOLERA

ITS NATURE, SYMPTOMS, HISTORY CAUSE AND PREVENTION,

With an outline Review of the

GERM THEORY OF DISEASE,

One of the Sommerville Course of Lectures (extended) provided for by the Natural History Society of Montreal.

DELIVERED ON APRIL 9, 1885,

BY

J. B. McCONNELL, M.D.,

Professor of Materia Medica and Therapeutics, and Lecturer on Practical Histology, University of Bishop's College Faculty of Medicine,
Consulting Physician to the Montreal Dispensary,
Attending Physician to the Western Hospital,
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PREFACE.

This paper on Cholera was prepared for one of the Sommerville Course of Lectures, but becoming so extended could be delivered only in an abridged form. The fact that many anticipate a visitation here of this pestilence during the coming summer, and that there is n available pamphlet on the subject published in the Dominion later than the memorandum on cholera issued under the supervision of the Department of Agriculture in 1866, induced me to have the paper after further extension and revision published in pamphlet form.

It is hoped that by the dissemination of such knowledge and instruction as it contains, communities will be aroused to adopt preventative measures, and individuals led to observe precautions which may disarm this dreaded invader and keep it from our shores, or mitigate its destructive ravages should its infection be implanted amongst us.

The article is entirely the result of a study of the literature treating on the subject, and is in certain parts a condensed compilation from the authors consulted. I am indebted chiefly to the following writers: Dr. R. Nelson, Professor Lebert, Dr. A. Stille, E. Goodeve, M.B., Mr. MacNamara, Dr. J. C. Peters, Dr. Leale, Dr. Gradle, Dr. Wight, Sir Thomas Watson, Dr. Pettenkofer, Dr. Koch, etc., besides the leading Medical Journals and Board of Health reports.

J. B. McC.

MONTREAL, 22nd June, 1885.

CHOLERA.

VARIETIES.

In view of the frightful ravages cholera is capable of making, a general knowledge of its nature cannot but be of interest, and great practical use to every member of the community. It has decimated the population of countries in almost every part of the world, and is no respecter of persons, carrying general suffering and death wherever it prevails. As we shall see in considering the history of cholera it is more than likely that this country will witness an epidemic during the coming summer. It has been advancing at an unusual rate from the east during the past three or four years, and has now reached the western part of Europe, where at this hour it is numbering its victims. It behooves us, therefore, one and all, not to be unmindful of the threatened danger, and to manifest a degree of concern in regard to this possible eastern invasion at least equal to that shown in the prompt and determined measures now being adopted by our citizens and country in order to subdue the less to be dreaded enemy which has risen in the west.

The term cholera is derived from two Greek words, signifying bile and to flow, and has been applied to several distinct affections. *Cholera Morbus*, also called *Simple Cholera* and Summer Cholera, Cholera Europea, Cholera Nostras, Sporadic Cholera, &c., is the disease to which the term is properly applicable, as the evacuations are, in the early stages at least, of a bilious character. This is the affection we find described in the works of Hippocrates, Galen, Celsus, Aretæus, Paulus Ægineta, Cœlius Aurelianus, and by the Greek, Roman and Arabian medical writers generally. The more malignant form of this disease, commonly termed Asiatic cholera, is not noticed by any of these ancient writers.

Simple cholera is an affection of nearly all hot climates, and is common during the summer and early autumn months in most temperate regions. Its occurrence is favored by various unsanitary conditions, such as impure water, noxious emanations from sewers and decomposing organic matters, overcrowding and residence in small, damp, ill-ventilated houses and in lanes where the scavenger's work is neglected; also by unusually high atmospheric temperature. The exciting cause is usually some error in diet, the use of tainted food, unripe fruit or vegetables, or excessive drinking of cold liquids during perspiration. It is not infectious, although in unhealthy localities it is sometimes so prevalent as to constitute a minor epidemic. The symptoms bear a close resemblance to those of Asiatic cholera, but the affection is seldom fatal.

Cholera infantum is the term applied to simple cholera occurring among children, prevailing chiefly in large cities and among the improperly nourished children of the poorer classes; and, when the treatment is not prompt and early removal to the country effected, the mortality is very great.

Asiatic or malignant cholera is the affection to which your attention is more particularly invited this evening. It has other synonymous designations such as cholera algida, C. asphyxia, C. spasmodica, epidemic cholera, blue and serous cholera, etc., these various terms indicating some of its more prominent features.

DEFINITION.

It may be thus defined: A specific disease epidemic in British India, from whence it may be conveyed and become epidemic in almost any part of the world, always following the lines of human intercourse; characterized by a rapid transudation of serum into the gastro-intestinal tract and usually by violent vomiting and purging, with rice water evacuations and painful cramps; by rapidly producing a state of the body known as collapse and tending to terminate rapidly in death; the dejecta having the power of producing the disease in other persons if taken into the system with their food, drink or otherwise.

SYMPTOMS.

Cholera may be recognized by the following symptoms, which must be regarded as typical only, for we find in this, as in all affections, marked differences in the degrees of gravity manifested; these variations depending on the susceptibilities of those attacked, the amount, and degree of virulence of the poisonous agent, which produces cholera when brought into contact with the intestinal mucous membrane. Some may have no previous warning of the attack, but are at once prostrated and smitten down with an unaccountable feebleness, unattended even with the usual evacuations, so sudden and overpowering is the action of the poison, or the depression may be speedily followed by profuse vomiting and purging and general spasms; if alone, the victim is unable to call for assistance and may die in a few hours just where he was seized, although previously in good health. On the other hand, this affection is sometimes so mild that it might easily be confounded with an attack of diarrhœa, the result of some indiscretion in diet; these cases being the most dangerous to the community, as they are more likely, through not being recognized in time, to be the means of spreading the disease. The term cholerine is applied to this variety of the disease.

There are usually three stages in an attack of cholera. In the first stage, or that of *invasion*,—which may, in a small percentage of cases, be preceded for some hours by a feeling of malaise, oppression at the stomach, depression of spirits, a pale and anxious cast of countenance, dizziness, headache and a sense of debility

—, there is diarrhœa, with nausea, and a feeling of exhaustion ; it may last from a few hours to a week. It is during this stage that proper treatment may arrest the disease. After a longer or shorter interval the second stage, that of *development* or *evacuation*, appears, in which there are copious fluid alvine evacuations and vomiting, recurring repeatedly, usually painless and attended with faintness, huskiness of the voice, pallor, coldness, and profuse perspiration. The evacuation have the appearance of rice water, consisting of serous fluid and di..n tegrated epithelium from the intestinal mucous membrane. There i an urgent thirst which cannot be satisfied, as liquid swallowed cannot, be retained ; fearful cramps now set in. The continued serous depletion of the system leads to symptoms of marked depression, the countenance assumes a leaden hue, the features are shrunken and pinched, eyes lustreless and sunken and cheeks hollow. The pulse fails, and temperature falls perhaps to 94° or 95° (normal 98 2-5°) although the patient complains of feeling hot. As little blood circulates through the lungs the breath is cold, skin is purplish, damp, doughy and shrivelled. The voice is reduced to a hoarse whisper (vox cholerica) and the patient sinks into a listless, dull, motionless state, although the intellect still remains clear. As the loss of fluid continues this condition becomes still more marked, constituting the stage of *collapse*, from which not more than 35 per cent recover. There is great restlessness, irregular paroxysms of gasping for breath, and shrieking from the agonizing cramps. The surface of the body is bathed in a viscid perspiration, cold and marbled ; patient is still conscious, but is apparently indifferent to his surroundings. He may remain in this condition from 12 to 48 hours. and recover, or may die in from two to 24 hours. The breathing becomes more impeded, brain more torpid, followed by insensibility and death.

If he is to recover, and the stage of *reaction* sets in ; it is recognized by a gradual rise of the temperature and return of the pulse, and the patient is gradually restored to convalescence, which may be protracted or a fatal result may still ensue from any of the complications which are apt to follow the attack, such as fever resembling typhoid, inflammation of the lungs, stomach, intestines, membranes of the brain, or parotid gland, or from arrest of the functions of the kidney, destruction of the eyes, abscesses, gangrene, or from the formation of clots in the heart or vessels of the lungs.

POST-MORTEM APPEARANCE.

After death the body appears shrunken beyond recognition, and presents livid discolorations. The temperature rises, and the body remains warm for some time. The *rigor mortis* sets in quickly, and is often accompanied with contractions of various muscles, which cause the limbs to be displaced. This fact explains the changed positions sometimes observed in buried victims of the disease. The hand may be raised to the head, the mouth may open and close, or the body turn over on one side, giving rise to the belief that they were buried alive.

In one case described the hands and arms closed together assuming an attitude of prayer, the eyelids may even open after death, and the eyes move. It has occasionally happened in cases of extreme collapse simulating death that in the haste to dispose of the dead, during the excitement of an epidemic, some have really been interred before life was extinct, and where reaction subsequently set in. The possibility of such a dreadful occurrence should urge extreme caution at such times. All the tissues of the body are preternaturally dry, hence decomposition does not set in early. The mucous surface of the stomach and intestines is pale if death occurred early in the stage of collapse; if it occurred after reaction had set in it will be congested and swollen, and its epithelial cells are loosened or thrown off according to the severity of the case.

Bacilli are found here, not ably the comma-shaped bacillus discovered last year by Dr. Koch, of Berlin, and supposed by him to be the cause of the disease.

The surface capillaries are empty, and the blood found of tarry consistence, chiefly in the venous trunks and right side of the heart and large vessels of the lungs. The latter are collapsed and dry if death occurs in the aljide stage. The absorbing powers of the intestines are destroyed, and the removal of the epithelium takes away the natural obstacle to transudation in the mucous membrane. "All the symptoms and lesions found in cholera can be explained by the loss of the fluid portions of the blood."—(Stille.)

HISTORY.

Cholera is said to be as "old as the human race in India, and the centres of departure of the great India epidemics of this disease are to-day as they have been from time immemorial—the mouths of the Ganges and Brahmaputra rivers." Accounts of the disease have been published at different times since the beginning of the 16th century, although reliable and thorough reports date back to the middle of the last century only. "The invasion of India by the Portuguese, and afterward by the English, contributed to spread the disease throughout the peninsula, partly by military occupation and partly through commercial channels, by which it was also carried to islands in the Indian ocean.

It prevailed in Batavia in 1629. Between 1768 and 1790 numerous epidemics of cholera occurred. About the former date no less than 60,000 persons are said to have perished near Pondicherry, and in 1783 it is reckoned that 20,000 victims to the disease fell in a single week during the religious gathering at the sacred city of Hurdwar.

The English armies extended their conquests in Hindostan and established commerce between that country and western Asia and Europe, and by the year 1819 opened new channels of communication

in every direction, both within and beyond the peninsula; along these the disease was carried." On August 19th, 1817, Dr. Tytler, of Jessora, a city situated in the delta of the Ganges, sixty miles from Calcutta, was called by an Indian physician to see a patient who had been seized in the night with the usual symptoms of cholera; as the patient was in a dying condition, he was about to report it as a case of poisoning when he learned that some seventeen other cases occurred at the same time and had quickly died. During the next two months over 10,000 of the inhabitants fell victims to the disease. This was the commencement of that fearful epidemic which ha now for years spread sorrow and desolation over almost all the lands of the earth.

It prevailed throughout English India in that year and reached Calcutta in September. An army under the Marquis of Hastings encamped on the banks of the Sind lost within a short time 8,000 Sepoys. The invasion was so violent that mounted men were stricken from their steeds fell and died on the road, which was encumbered with the ill, dying and, dead.

In one month the epidemic was over, no new cases occurring. In this year the number of cholera victims is given as 600,000.

In 1818 cholera spread over all Bengal, it also passed over the high mountain ranges of India and Nepal, and raged in the mountain valleys 4,000 feet above the level of the sea with the same virulence as upon the plains. It also appeared at Malacca.

In 1819 the intensity of the epidemic diminished in a marked degree but it extended more widely; town after town and village after village in succession were invaded, regardless of topography. The islands of Penang, Ceylon and Sumatra suffered, the latter losing 102,000. It was also conveyed to the Mascarene Islands by a frigate.

In 1820 it prevailed in Bengal, the Phillipines and in China.

In 1821 it spread along the Persian Gulf and through Persia and East to Burmah and Java, the latter losing 100,000 inhabitans.

1822 finds it in India, Russia, Syria and along the southern shore of the Mediterranean.

In 1823 it ascended the Caspian sea to Astrakhan, Russia, appearing again along the east and south shores of the Mediterranean. China also suffered severely.

A lull now occurs until 1826 and 1827, when it appeared again in India and spread north to the Aral Sea.

In 1828 and 1829 and 1830 its ravages were confined chiefly to Russia; Sebastopol Odessa and Moscow suffering severely.

In 1831 pilgrims brought it from India to Mecca, where 50,000 perished out of 100,000 assembled there. It was conveyed by them to Syria and Egypt, and it also appeared in Constantinople and St. Petersburg and raged throughout Russia, spreading to Poland and Germany, prevailing also in Finland, Sweden, Hungary and Austria, and other places in Northern Europe.

From Hamburg it crossed over to the east coast of England, reaching

Sunderland on October the 26th. It spread from this point, and in January, 1832, attacked London, Edinburgh in February, and Dublin in March.

From England it was carried over to France, attacking Calais and Paris in March and later other parts of France, destroying altogether there 120,000 people, 7,000 of whom died in Paris in the space of eighteen days.

In this year cholera first crossed the Atlantic ocean and reached this country. By direction of the colonial office, London, the Governor (Lord Aylmer) sent a message to the House of Assembly on February 3rd, recommending that a Bill should be passed for quarantine and health purposes. About the 12th the Bill was reported and passed, it being the first quarantine and sanitary measure enacted in Canada. It empowered the Governor to name a board of health and establish a quarantine station at Grosse Isle, below Quebec. He established a military post there, with officers to command and a small battery to enforce obedience from passing vessels. A similar board of health was created for the cities of Quebec and Montreal.

The following vessels arrived at Quebec early in the spring:—The Robert, from Cork, on May the 14th, had ten deaths from cholera, the last 23rd April. The Constantia, from Limerick, 170 immigrants, lost 29 in 15 days. Elizabeth, from Dublin, 200 immigrants, lost 22. Carrick, from Dublin, arrived June 3rd, lost 42 in the first 15 days out. All well on arrival. A woman was attacked after landing at Grosse Isle. Brig Brutus, from Cork, 270 immigrants in a few days had many deaths. After that all well. The vessels were detained a few days at Grosse Isle, and the passengers sent ashore, they and the vessels well cleansed and thoroughly aired, after which they were permitted to go to the end of their voyage, Quebec. The first cases of cholera in Canada appeared in an immigrant house on Champlain street, Quebec, on June 8th, 1832, among passengers brought there by the St. Lawrence steamer, Voyageur. It spread rapidly, carrying off over 4,000 of the inhabitants.

The same steamer carried a load of immigrants from Quebec to Montreal, no stoppages, arriving here on June 9th, in the afternoon, being 30 hours on the way. After the passengers with their baggage had left the wharf for the entrance of the Lachine canal, a man left behind was observed lying on his back in a dying condition. He was seen by Dr. R. Nelson, Dr Arnoldi, and several other physicians. He died shortly after. A soldier from the garrison here spent the night with some of these immigrant who were related to him. Next morning, June 10, Dr. Nelson was was called to their lodgings, in a hotel near the port, and found a woman and a man, of those who had arrived the previous evening, dead, and the soldier blue and dying; he died in twelve hours. The same morning Dr. Nelson visited two other cases, one in Sanguinet street and another on St. Constant street; both men had spent the previous day at work on the beach, and had joined with the curious to look at the dying immigrant on the wharf. Many other cases occurred the same day, and

its spread was rapid; by the 12th over one hundred cases lay unburied at the Roman Catholic burying-ground, St. Antoine suburbs. The health commissioners threatened a resort to cremation as a means for their disposal. This aroused the people. The gentlemen of the Seminary addressed them at the church door, and then they turned out and dug trenches 10 feet wide, 8 feet deep and over 100 feet long, where the dead were packed in tiers. Several of these trenches were filled.

Business was paralyzed, physicians and ministers rushed from place to place, day and night; druggists kept open all night; the dead carts followed each other in quick succession, with loads of coffins; the latter becoming difficult to procure, the health authorities had them constructed of rude boards, and they were furnished to all who applied for them. It was no unusual thing for the carter of the dead to call out on passing the houses, "Have you anyone to send to the burial ground?" In this way he would get from two to four at a load and call at the health office for his pay. Temporary hospitals were put up, Dr. Beaubien and some medical students taking charge. These were in attendance night and day. A number of dispensaries, under trusty students, were established, which supplied medicines gratuitously night and day to all who applied. There were thirty physicians in the city; the population, of which was at that time 32,000, over 4,000 are said to have died. By September 29th the scourge had ceased, lasting less than three months.

This epidemic illustrates the infectious nature of cholera. The rapidity with which the poison may prove fatal is illustrated by a case recorded by the health commissoner. A man came to him about 12 o'clock at night to get an order for a coffin for his wife. In less than an hour after he had left, among others, on the same errand, one brought him word that a man was lying on the pavement opposite the English Episcopal Church. Relief was at once sent to him, but life was found to be extinct. In his vest pocket was found the order he had received less than an hour before. The good results of isolation were illustrated by an expedient resorted to by the commander of the garrison of Montreal; out of 400 men 46 had succumbed to the disease, when, on June 19th, the men were put under canvas on St. Helen's Island, and strict seclusion and exclusion enforced, with the result that no other deaths occurred. Post-mortem movements were illustrated in the case of a Miss Hervieux; many believed at the time that she had been buried alive. She died while spending the evening with a lady friend and was buried before morning, without her parents being notified, in the dress she died in, and with her jewellery on her. A twitching and movement of the limbs was observed previous to her removal from the house. That clothing, &c., may carry the infection was illustrated in the house of a bookseller on St. François Xavier street. A minister who resided with him left for Upper Canada, took ill with cholera, and died on the way. His valise, containing some clothing worn by him, was returned to his house in the city; three children overhauled

its contents; in 12 hours after they were attacked with cholera. While the pestiferous steamer Voyageur was on its way from Quebec, about a mile above Sorel, a feather bed was thrown overboard; a man paddled out to it in a canoe and brought it home to his wife; both died of cholera, the former in 12 hours.

Although the greatest mortality occurred among the lower classes of society, many leading citizens living in the healthiest parts of the city, surrounded by all the comforts which wealth and intelligence could procure, fell victims to the disease. No cases occurred at Three Rivers for some time after the disease broke out in Quebec and Montreal. This immunity was attributed to the fact that they forbid steamers landing there. A retrograde traveller from Sorel, which was early affected, being a landing-place, brought it later on. From Montreal it soon spread in all directions, chiefly by immigrants who were forwarded by the Immigration Society as fast as they arrived. Lachine was first visited, then the Cedars, next Coteau du Lac, Cornwall, Prescott, Kingston, Toronto, Niagara, Sandwich in Upper Canada, and the opposite towns in the State of New York, spreading from town to town until it reached New Orleans; and from Montreal to St. Johns, thence to Champlain, Plattsburg, Whitehall and Albany. Travellers up the Ottawa carried cholera to Rigaud, Carillon, Grenville, Plantagenet, and so on, until Bytown (now Ottawa), the end of travel, was reached on the 5th July. It was brought there by a woman passenger on the steamer Shannon. She died the next day after her arrival, and the landlord of the house and others in attendance on them also died. From this focus it spread through the town. Of the attacked, 88 died.

An emigrant steamer reached New York in July and brought the germs of cholera, which spread through the city, the mortality being about 3,500. From there it spread up the Hudson and south to Philadelphia and other places westward.

In 1833 the disease broke out in Cuba, destroying 1-10th of the entire population; from that place it was carried to Mexican and American towns of the Gulf of Mexico and up the Mississippi and Ohio as far as the western border of Pennsylvania. The epidemic had almost ceased this time in Europe when it again broke out in Portugal, and during this and the following years spread eastward to Spain, France and Italy and a large part of the Mediterranean coast.

In 1834 it was again introduced at the port of Quebec in the latter part of May, by a vessel filled with immigrants, of whom many had died during the passage. It affected so mild a character that it was not considered to be confirmed Asiatic cholera, and it preserved its mild form for a short period. It assumed a more violent character through Canada at the end of July and during the month of August, but finally disappeared with the month of September, the sanitary commissioners having held a high mass of thanksgiving in the cathedral of Quebec on the 2nd October; the epidemic lasted four months.

It prevailed in the United States during this and the two following years.

In 1836 Italy and Germany suffered, and in 1837 it prevailed chiefly in Germany and Algeria. With the year 1837 this almost world-wide epidemic, lasting 20 years, came to an end. During its progress millions of people were destroyed. It prevailed regardless of climate and soil, on mountains as well as at the lowest levels.

In 1845 cholera again prevailed in India, especially along the courses of the Ganges and Sind. It spread through Asia and Europe, taking a course somewhat similar to the first great epidemic, reaching England in October, 1848, at Sunderland, the same town at which it first appeared in 1831. From England it spread to France. Vessels from Havre brought it to New York and New Orleans. In the former city it was confined to the quarantine grounds. The Swanton reached New Orleans on Dec. 11; no quarantine was established; the sick were taken to the Charity Hospital; this was followed by an epidemic which continued all winter, and from this it advanced up the Missouri river and through the whole Mississippi valley and to California.

In 1849 it again appeared in New York, proving fatal to 5,000 persons, and entered Canada by Kingston, where it first appeared at the end of May. Some slight cases occurred in Quebec on the 11th July and a few more on the 12th, and then spread through almost the whole of Canada, its ravages being in some places greater, in many places less, and also generally less destructive than in 1832. It seems to have disappeared entirely about the middle of October after a few days of recurrence in Montreal, having lasted about four months and a half. 496 deaths occurred in Montreal.

The 4th epidemic of cholera in Canada took place in 1851. It was introduced through the States, and Quebec was the last of our cities to receive it. The appearance of the plague took place under a rather mild form in August, and the last cases were observed no later than the first day of October. It lasted only about two months, taking Canada as a whole, and only five weeks in Quebec, and was fatal there to 206 persons.

A third epidemic began its ravages in Persia in 1850, doubtless brought there from India, and again travelled on its former path through Russia, Prussia and the Scandinavian countries, reaching England and France in 1853, remaining during the following year. In England 16,000 perished and in France 114,000.

In 1854 it was again introduced by emigrant ships to New York and spread and extended thence along all the emigration channels. It first entered Canada at Quebec on the 20th June by two ships from Liverpool—Glenmanna and John Howell. The former had lost a number of passengers from cholera, the latter none, but had 5 deaths from measles. They both disembarked their sick at the quarantine station, Grosse Isle, and two or three days after proceeded to Quebec with the rest of their passengers. The two ships were inspected on the same day—17th June—in the port of Quebec and found free

from sickness ; they remained so for two days, the immigrants were permitted to go ashore, some of them returning to the ship for meals and to sleep, when on the 20th the cholera broke out almost simultaneously in both ships, whence several cases were immediately sent to the marine hospital. Then it appeared on other ships, and subsequently spread from Quebec and apparently following the course of the immigrants in their journey west. It appeared in Montreal on 22nd June, remaining until the 22nd September, causing the death of 1,186 persons. It reached Kingston on the 25th, the first case being a resident who is said to have had no other communication with the immigrants than looking at them on the wharf, but he was a man of intemperate habits and in miserable circumstances. It reached Toronto city on the 25th, and Hamilton on the 23rd. The epidemic lasted 3 months; the minute book of the central board of health records 3,486 deaths, which doubtless falls short of the reality, and this was the mildest of the five epidemics. Brockville escaped entirely, although immigrants had landed there. In this year and the following it prevailed in Switzerland, and 1855 in Brazil.

Another interval of ten years now elapsed during which little was heard of cholera. In December, 1864, it broke out among pilgrims at Mecca, and was carried to Egypt, to Europe, and from there to North America and the West Indies. In 1866 it was introduced from Europe to Halifax, N.S., the city of New York and the military posts of New York harbor, and prevailed at numerous points throughout the Union, recurring again in many of the same places in 1867.

Between 1865 and 1874 cholera prevailed to a greater or less extent in the east of Europe, and after that date it is heard of only in Syria, Arabia and the African shore of the Mediterranean.

The latest appearance of cholera in North America was in 1873, in the adjoining Union, where it occurred at three points far distant from one another. "It was introduced in the effects of immigrants. The vessels that brought them were in perfect sanitary condition. The passengers themselves were healthy, and remained so after landing until they reached the distant points of Carthage, Ohio ; Crow, River, Minn ; and Yankton, Dak., where their goods were unpacked. At each place, within 24 hours after the poison particles were liberated the first cases of the disease appeared, and the unfortunates were almost literally swept from the face of the earth."

In 1881 and 1882 cholera prevailed in Arabia, brought by pilgrims to Mecca. Its proximity to Egypt, where a civil war was in progress, and where English troops were engaged in subduing a rebellion, impelled the authorities to adopt stringent measures against its importation, which were successful, but the following year those precautions were relaxed, and at the end of June, 1883, cholera appeared in Damietta and from there extended throughout Egypt. At Cairo 600 deaths occurred on June 20th, and in all Egypt during the week ending August 13th, the total mortality is said to have been 5,000, and altogether the epidemic was fatal to at least 20,000 of the inhabitants.

The reports of the ravages of cholera in Toulon, Marseilles and Paris during last summer (1884) are still fresh in the minds of all.

The question now presents itself, where will it prevail in 1885? This last epidemic is travelling westward by a shorter route than previous ones. Instead of passing northward over the Caucasus or along the shores of the Caspian sea through Russia and westward through northern Europe to England and across to France: its steps are, India, Arabia, Egypt, France and Spain.

Should cholera be epidemic again in western Europe this coming summer the likelihood of the infection being conveyed across the Atlantic, in view of the past history of cholera, amounts to more than a probability. At a recent meeting of the Medical Society of the County of New York, Dr. J. C. Peters who read a paper on the subject of cholera—expressed his belief that this year it will prevail in Spain, be conveyed from there to Cuba, and from there to the Southern States.

We learn from the press despatches that cholera had reappeared in Toulon last month, and one dated the 7th inst (April) states that at San Falipe de Jativa, province of Valencia, Spain, where destructive earthquakes prevailed recently, cholera had appeared, of a virulent type, and was spreading rapidly, causing a panic among the inhabitants.

At the present date (June 22nd) cholera is raging throughout Spain; hundreds dying daily.

THE CAUSES OF CHOLERA.

This subject is one that has engaged the attention of scientific physicians during the last fifty years, to an extent quite equal to the great importance which attaches to it. Not only has there been patient, painstaking investigations by eminent men individually, but Governments have at various times appointed commissions for the sole purpose of making researches in this direction. During the last few years the Governments of Germany, France, Italy and England have done much in promoting such special inquiries.

It is of the greatest consequence, in order that proper preventative and curative measures may be intelligently and scientifically employed and recommended, that the specific cause or entity of this disease should be known, otherwise all attempts to hinder its advent or check its progress must necessarily be of an empirical nature.

The conclusions arrived at as a result of the study of cholera have not always been identical, and thus various theories have arisen in regard to its cause and other features of the disease. It is held by most authorities that cholera is a specific disease, originating in India; by others that it may arise spontaneously in any country, and own no cause. One view regards the affection as being propagated only from the patient and his surroundings, another that it is spread by merchandise, by healthy individuals, and by atmospheric currents. There is a like discrepancy in the views on the possibility of its diffusion by drinking water, on the influence of the conditions of soil, on the question whether the dejecta contain the poison or not, and on the duration of the incubation period. It has been

generally conceded that the cause must be a specific germ, but whether it was of a bacterial nature or fungoid, or an animal parasite, was not known until within a little over a year, when Dr. Koch announced the discovery of a bacillus, which he believed to be the essential cause. We will better comprehend this interesting subject after a brief general review of the facts relating to disease and other germs.

THE "GERM THEORY OF DISEASE."

It was a Dutch microscopist named Leeuwenhoek who first announced, in the year 1683, the discovery of these minute micro-organisms which are now known to be so intimately connected with the processes of disease, fermentation, decomposition, &c., but the knowledge which we now possess on this subject is chiefly the result of researches made during the last twenty years. Conspicuous among those who have labored in this field stand the names of Louis Pasteur and Dr. Robert Koch, although much has been revealed by the works of the following investigators, Cohn, Rayer and Davaine, Loeffler, Toussaint, Chauveau, Buchner, Klebs Tommasi Crudeli, William Budd, Watson Cheyne, Billroth, Ehrlich, Lukomsky, Klein, Vandyke Carter, Luginbuehl, Oertel, Hansen, and many others. Evidence is daily accumulating that many of the diseases to which flesh is heir, especially those known to be infectious, depend on the invasion of the organism by microscopic parasites, or their germs, which, developing in the body, set up a disturbance which manifests itself in the symptoms observed as characteristic of each disease; each affection having a distinct species of parasite, which has peculiar characters, and flourishes in particular parts of the organism, whose normal functions are thus interfered with. Parasitism prevails throughout the animal and vegetable kingdoms; smaller species live upon and derive their sustenance from those higher up in the scale of organization. Most of the diseases to which the higher plants are subject, are the result of fungi preying upon them, and instances are numerous where lower forms of animals are parasitic in the bodies of higher beings.

The disease in the human subject called trichinosis is the result of the introduction into the stomach, chiefly through imperfectly cooked pork, of a nematoid worm, *trichina spiralis*. These worms are found in the flesh of many other mammals besides the pig, and are exceedingly tenacious of life, living after the death of the animal and its complete decomposition; are unaffected by the ordinary means of curing meat, and are frozen with impunity. In perfectly cooked meat the parasite is destroyed, but any temperature less than is required for this purpose is likely not to injure them. In the stomach the cysts containing the worms are digested, and the latter set free, and they pass to the intestines where they mature and give birth to numerous young trichinæ; these at once pass through the intestines and migrate through the body to the muscles, where they coil and become encysted; as many as 80,000 have been counted in a cubic inch of flesh. Great suffering and fever is caused by their move-

ments through the body, which frequently ends in the death of its host.

A much more common cause of disease in animals is the development within or upon them of organisms belonging to the vegetable kingdom. In man ring worm is a familiar example, the result of a species of fungi attacking the hair follicles of the skin.

But the germ theory of disease refers to the introduction into the system of the lowest type of plants, which from being found in the body in connection with many specific diseases are supposed to be their cause. They belong to the lowest group of plants, the protophyta, class schizomycetes, order bacteriaceæ. These minute plants (bacteria) consist of a single cell and reproduce themselves by dividing into two (fission) and these again into two, and so on as long as they are provided with nutriment; failing which they form a powdery precipitate which is regarded as a resting state. The spores thus formed have the power of germinating again when the surroundings are favorable.

Bacteria require moisture or fluids for their development, they consist chiefly of protoplasm, have no chlorophyll, and are sometimes provided with cilia (also called the flagelli) which by their lashings enable them to move about in liquid media. The cells sometimes appear in groups, held together and separated from each other by a jelly-like matrix, formed by a partial degradation of their cell walls, this is called the *zooglea* form. Pasteur terms bacteria which require free oxygen, *aerobies*, and those which can live without free oxygen, but have the power of wresting it from its combination with other elements, *anaerobies*. There are three sub-divisions or genera of bacteria:— I. Micrococcus, when the cells are round or elliptical; diplococcus, two of them joined together; streptococcus, if united into a chain. II. Bacillus, cylindrical, rod-like or filiform cells. Cohn termed curved filiments vibrios. III. Spirillum, spirally twisted or screw shaped cells.

In order to detect these minute and almost invisible organisms and study their characters and habits, microscopes magnifying from 400 to 1,000 diameters are required. They are so minute that, according to Dr. Dallinger, 50,000,000 would not occupy a space greater than the 1-50th part of a cubic inch. They are found where ever organic matter, animal or vegetable, is undergoing decomposition, in stagnant water and all solutions containing organic substances, and dried bacteria or their spores are found in myriads adhering to every object around us and to the minutest particles of dust floating in the air, seen in a ray of sunlight and which make the ray visible.

Decomposition and fermentation are terms which possess the same scientific signification, and indicate the softening and liquifaction of animal or vegetable matter and the splitting up of its complex organic molecules in more simple combinations. Popularly the terms putrefaction and decomposition, or rotting, are used when the resulting products are obnoxious to the nose, and fermentation when closely allied changes are free from any disagreeable odor. The changes which take

place are the result of the life-work of bacteria and it is now an accepted axiom that "No putrefaction can occur without the presence of bacteria, and that bacteria are the sole and only cause of decomposition." This is proved by the fact that all agents which destroy the bacteria or arrest their development in any organic compound also stop putrefaction, and if their entrance into such compound is prevented no decomposition will occur.

The destruction of all bacteria in an organic solution is termed sterilizing it, and is usually accomplished by heat. The boiling point of water is sufficient to kill all bacteria when in a moist and active condition, but different species vary in the degree of heat they can withstand. And their spores require a much higher temperature to destroy them. Tyndal's method for completely sterilizing a solution is by repeatedly boiling it at intervals of several hours. Boiling kills all the developed bacteria, and when the fluid cools to a certain point the spores germinate, in which condition they are easily destroyed. An organic solution thus sterilized will never decompose if preserved from exposure to the air or other source of infection with bacteria. This can be done by hermetically sealing it, or by plugging the entrance of the vessel containing it with densely packed sterilized cotton, which completely intercepts the passage of the minutest germ.

Bacteria multiply very rapidly. According to Cohn a new generation can form in an hour. If sufficient nutriment was furnished, at this rate of increase in three days it is calculated that the scarcely conceivable number of 4,772 billions would be produced, weighing 7,500 tons. Gradle says:—"A growth not far behind these marvellous figures can be observed when bacteria invade a solid soil—for instance a cooked potato—the merest speck with which the soil is infected will grow at the proper temperature at such a rate that within a day the whole potato is transformed into a bacterial mass." This prodigious power of development would seem to explain the rapid spread of such diseases as cholera, yellow fever, typhus, &c.

Bacteria will grow in very simple solutions, although they thrive best in the presence of abundance of organic matter. Pasteur's cultivating solution contains only 1 part tartrate of ammonium with the ashes of 1 part of yeast in 100 parts of water. Bacteria require a certain amount of heat for their development, which varies with different species. Cold benumbs them, but they revive when warmth is applied, and their energies increase in proportion to the degree of heat until a certain point is reached, when their growth ceases and they are destroyed. No adult bacteria can in the moist state live after a long exposure to 60° C. (140° F.) and a higher degree in the dry state. The spores of bacteria are not so susceptible to extreme temperatures; they are in fact of all living matter the most difficult to destroy, and can live almost indefinitely. A temperature not less than the boiling point of water (212° F., 100° C.) is required to destroy them, and in the dry state 150° C. (302° F.) is needed.

Although bacteria must cease growing when the supply of food is

cut off, this often happens when nutriment is still left, the process of multiplication stops, and they are deposited at the bottom of the vessel either in a dead state or as spores. It is a remarkable fact that in a soil in which bacteria have ceased to multiply it is impossible to raise another crop of the same kind on infecting the solution again with fresh bacteria or their germs. The nutritious fluid possesses immunity against a second infection, probably owing to the loss of some chemical constituent. The analogy here to what we observe in the case of infectious diseases which the germ theory presumes are the result of pathogenic germs, is striking; one attack of an infectious disease generally confers immunity from subsequent ones, and their course is usually limited. Besides heat and cold bacterial life is checked by violent agitation.

Substances which can kill bacteria or check their growth are termed disinfectants or antiseptics. Most chemical substances in sufficiently concentrated conditions will prevent their development. The destruction of foul odors does not always mean the death of the bacteria, the agents of putrefaction and doubtless disease. Koch has shown that it is not easy to kill even the developed bacteria, while the spores defy most so-called antiseptics. He found corrosive sublimate or bichloride of mercury to be the most powerful of all disinfectants, one part in 5,000 instantly destroying spores, and one in 330,000 permanently checking bacterial growth. Dr. Miquel found the bin-iodiode of mercury to be 3 times stronger than the bichloride. Next to corrosive sublimate he places bromine, iodine and chlorine. Carbolic acid, he found, was not so reliable as is generally supposed, requiring a five per cent solution to kill the spores, and then only after from one to two days contact; one in 400 or 500 is required to check bacterial growth, and $\frac{1}{2}$ to 1 per cent. kill developed bacteria in two minutes. He found carbolic acid quite inert to bacteria or spores when dissolved in oil or alcohol. Very few other agents were found capable of destroying spores within twenty-four hours. They were destroyed by a five per cent. solution of per manganate potassium and one per cent. sol of osmic acid, a five per cent. sol. of chloride of iron took six days to destroy them, which neither sulphate of copper nor chloride of zinc was capable of doing. Sulphurous acid was found unreliable; one per cent. by volume in the air will in twenty minutes kill developed bacteria, but has little or no action on spores. The mineral acids in diluted solutions will not destroy spores. He states also that allyl alcohol 1 part in 167,000, oil of mustard 1 in 33,000, arsenite of potassium 1 in 10,000, prevented the growth of bacteria.

Another important fact in regard to these micro-organisms is that when one species is better adapted to the soil than co-existing ones, the latter are soon exterminated, an illustration of the survival of the fit test. Bacteria with strong reproductive powers crowd the weaker ones out. Whether it is by monopolizing the food or oxygen that they gain the ascendancy or by the formation of poisonous products is not yet known. Allied to this fact is another that "when bacteria develop in the interior

of the animal body there occurs likewise a struggle for existence between them and the animal cells, and here if the parasites prevail the animal dies, or if the battle is won by the tissues he recovers." The resistance varies with the kind of bacteria and the species of animal. One animal will be subject to the influence of certain germs which have no effect on others, and individuals of the same species evince different degrees of susceptibility, the predisposition depending on peculiarities of constitution not understood.

It may be regarded as an established fact that each species of bacteria retains perfectly its shape and chemical and vital properties under all circumstances, although the degree of energy varies. Pasteur has shown that bacilli allowed to remain for months in the same flask gradually lost their vital power, and if animals were inoculated with them (he experimented with the parasites of chicken cholera) instead of producing fatal results—the effect of the unattenuated bacteria—only a mild form of the disease was developed, but they retained their original virulence indefinitely if transferred from time to time to a fresh soil; left 9 months they could not produce the disease in chickens, but would still grow in a fresh cultivating solution; left still longer they died. Pasteur also showed that this altered degree of virulence is transmitted unchanged through successive generations, when the bacteria thus enfeebled are cultivated in a fresh soil. Hence this lessening of vital energy would diminish its power of competing with other bacteria or animal cells.

These facts would seem to explain why epidemics vary in severity, and are usually most fatal at the commencement. In the disease called anthrax, which is sometimes very prevalent among sheep and cattle, causing a large mortality, an attack confers immunity from a subsequent one, as we see with most infectious diseases. Pasteur, by inoculating with an attenuated virus, produced a mild form of the disease, and according to the degree of attenuation he could produce a disease of a corresponding degree of severity. He found that cattle and sheep inoculated twice at intervals of 12 days could resist inoculation with the most active anthrax poison; he inoculated 79,392 sheep, and the percentage of deaths was reduced from 9.01 to 0.65. A great demand at once arose for his virus, and up to the end of 1883 500,000 had been inoculated.

How bacteria set up fermentation or give rise to disease is not yet known. In some cases they secrete soluble ferments which act independent of the parasite generating it; in others the change occurs in the interior of the living cells, but the energy of this vital power is greatest at the temperature which is most favorable to their growth.

Bacteria are found on all parts of the surface of the body, are inhaled with each inspiration, and taken into the stomach with food. They thrive best in alkaline solutions; in the stomach the normal acid there checks their growth, but they thrive luxuriantly in the intestines where the secretions are alkaline, and are supposed to assist in

normal digestion, but in living, healthy animals they do not exist in the blood or tissues. The latter must have the power of overcoming the ordinary bacteria of putrefaction, but certain species are capable of holding their own there and multiplying, when a disturbance in the animal economy is produced, which is shown in the symptoms of the various infectious diseases. These are disease-producing, or pathogenic germs, and have been found to occur associated with and doubtless the cause of anthrax, pyæmia, septicæmia, erysipelas, glanders, typhoid fever, relapsing fever, small-pox, cow-pox, sheep-pox, measles, tuberculosis, malaria, diphtheria, leprosy, whooping cough, syphilis, endocarditis, croupous pneumonia, and more recently cholera and hydrophobia. In the latter disease Pasteur has attenuated the germs and by innoculating dogs with it has rendered them insusceptible to the influence of the most potent rabic virus. Should the investigation still in progress more fully substantiate these results, we may soon hear of some of our advanced boards of health adopting laws making compulsory the innoculation of all dogs in their jurisdiction, thus effectually banishing that terrible disease hydrophobia. Pasteur also discovered that pebrine, the disease which in France proved so destructive to the silk worm, was caused by a species of germ, and by studying its character under the microscope was enabled to suggest means for its extermination, thus protecting the silk industry from the immense pecuniary losses which up to 1865 had been experienced as the result of this disease. By the microscope also he discovered the organisms which cause the diseases of wine and beer, and suggested effectual remedies. The process in respect to beer was called pasteurization.

No other theory of cholera or other infectious disease would so fully explain all their characteristic features as the doctrine that they depend on distinct species of micro-organisms, which has been advocated so long by the ablest writers on the ætiology of disease. The recognized power the virus has of multiplying itself within and outside the body; the fact that it develops only when organic nutriment is furnished, and requires heat, moisture, and oxygen; the deleterious influence of cold, high temperatures and drugs inimical to plant life; the power the poison has of retaining its virulence on articles of clothing, etc, after long intervals; the fact that the poison of each infectious disease has distinct characteristic actions upon the system, which are uniformly maintained although in varying degrees; the period of incubation, self-limitation, and definite duration, can only be clearly explained on the theory that the cause is a living organism, each disease having a distinct species of parasite. The fact already fully demonstrated that some infectious diseases are produced by parasitic plants would seem to place the view beyond theory and be by analogy a very strong argument in favor of the opinion that all are likely to own a similar cause. Hence an important field of bacterioscopic inquiry opens up: the discovery of the germ belonging to each affection and the study of its peculiar characteristics, what circumstances and agents favor its development, and what hinders. In this way we may hope that in the near future the

treatment of these affections will be removed from the empiricism which has hitherto prevailed, and a rational, scientific system of therapeutics pointed out. As yet the agents found to be destructive to these bacteria outside the body would, in the strength required, be fatal to the patient if administered as remedies. The discoverer of a remedy which will arrest the development of bacteria in the system and at the same time be innocuous to the host, will confer a boon on humanity that will place his name among those of the highest rank of human benefactors.

The London *Lancet* says, in speaking of the recent Health Exhibition in London, where bacteriological appliances and methods were prominent features, "We cannot doubt that one result of the Health Exhibition will be to quicken public intelligence and interest in this question. The most highly-civilized nations of Europe, with their large armies, are painfully at the mercy of bacteria. It is these agents that we have to consider, their natural history, their relations to fermentation and to disease; how they can be fostered and how developed in air, water, soil or food, how they can be rendered innocuous or converted into beneficial vaccine agents."

NATURE, PREDISPOSING CAUSES, HOW IT SPREADS, INDIVIDUAL SUSCEPTIBILITY, &c.

We can now, after a general reference to the germ theory of disease more readily appreciate the circumstances which appear to favor the more widely accepted view that cholera is dependent on a germ for its causation, and can more intelligently comprehend the recent investigations on this point which have, it would seem, demonstrated such to be the case.

In the first place, the way cholera spreads from its source in India and from place to place and its undoubtedly infectious nature, is best explained by the parasitic theory. It invariably spreads from one infected place to another through some human agency, or by articles which have been exposed to the cholera poison derived from human beings, subjects of the disease, and does not spread through the atmosphere in the direction of or with the same velocity as prevailing winds, as we might expect if the theory that an aerial poison was its cause was true. It never moves from one place to another more rapidly than can be accounted for by the movements of human beings, and will appear first in places at a long distance from where it is raging, leaving intermediate places free. It will also spread in a direction against a prevailing wind, and when it reaches a place does not usually appear simultaneously in different parts of a locality or city, but gradually spreads from some focus at a rate no greater than can be explained by the degree of intercourse among the inhabitants or by an infected water supply; if the first cases are isolated and proper sanitary measures are enforced an epidemic is often nipped in the bud. Dr. Peters, of New York, states that of fourteen epidemics of cholera at Staten Island, the quarantine station of New York, all but four were prevented from reaching that city. Cholera usually prevails in the hot seasons of temperate climes, and its origin in the torrid region of India are facts

in harmony with the view that bacteria are its cause. We know that they require warmth for their development. The influence of cold is shown in the following instance: In 1850 a ship from Liverpool bound for Philadelphia was attacked with cholera. On the day on which the greatest number of new cases and deaths occurred, a large iceberg came in sight, lowering the temperature many degrees; from that time the cholera on board ceased. No more cases occurred. Its prevalence in northern climates is explained as follows: The intense cold of the winter compels the inhabitants to heat their houses by every possible means, preventing ventilation, while the atmosphere within them is kept at high temperature by huge stoves; the imported germs find here the conditions favorable for their development. Many of the poorer classes use snow water, and as the snow about the houses receive all refuse matters, portions of cholera excreta may thus gain an entrance into the system through the drinking water.

Many of the predisposing causes of cholera are such as would favor the development of bacteria, but it must be borne in mind that they will not of themselves give rise to the affection. Cholera must always be imported from a region already infected, but such conditions as hot weather and a moist state of atmosphere, poverty, crowding, want of cleanliness, the presence of organic refuse, bad drainage and sewer emanations, and all such bad hygienic surroundings are generally supposed to promote its development, although there are instances on record where foul and filthy places have escaped, while healthy localities in close proximity have suffered severely, and again places where every sanitary precaution had been observed have been ravaged.

The specific cause of cholera is generally supposed not to act by entering the lungs and thence passing through the system like small-pox, &c., but to enter the alimentary canal, and there its further development gives rise to the symptoms observed in this disease. It is conveyed from the sick to the well by means of the gastro-intestinal discharges, usually in a moist condition. Drinking water is supposed by many to be the chief medium for the conveyance of cholera, and the importance of a pure water supply is generally insisted upon, but no matter how impure drinking water is it will not give rise to cholera unless it contains the poison. Water contaminated with organic impurities is favorable to the growth of organic germs, and even large quantities of water of this kind if infected with the minutest quantity of cholera poison will soon all be rendered capable of giving rise to the disease, which can only be explained by the known methods of rapid development observed in bacteria. Not only will infected liquids cause the disease when swallowed, but the vapory emanations from them contain the poison germ to a certain extent and may reach the throat and be swallowed. This explains how washer-women are so very liable to contract the disease while washing infected clothing, but it may happen in these cases that some of the water by splashing or by the hands may be directly conveyed to the mouth.

There are many facts which go to prove that the germs do not exist to any great extent in the air; thus when proper precautions are observed the

mortality among those in attendance on cholera patients is not great. Physicians, nurses and those who bury the dead, and so on, are so seldom affected that Professor Lebert considers it an accident when any such are attacked. If a room containing a cholera patient is not well ventilated the germs may exist in the air to such an extent that it becomes dangerous to enter it, but in well-ventilated rooms and in the open air the risk of infection through the atmosphere is not great. That contaminated water is the chief method of conveying poison to human beings is proved by numerous instances, although there are some unbelievers in regard to this point, as there are in regard to many others generally accepted. The number of instances recorded where drinking water appeared to convey the disease would fill volumes. We need only mention two, quoted from Stille, in Pepper's System of Medicine. In 1861, at a station in India, some fresh cholera poison found its way into a vessel of drinking water. Early on the following morning a small quantity of this water was swallowed by nineteen persons, five of whom were attacked with cholera between the first and third day afterward. Saheb Ragau is the particular locality in which Dr. Koch discovered the comma bacillus, supposed to be the true cholera germ. It has repeatedly been visited by cholera during the last hundred years. When visited by him numerous cases of the disease had been reported, and these on inquiry were found exclusively in the huts situated around a certain tank. Of the few hundred people who dwelt in these huts as many as seventeen died of cholera, though the disease was not at that time prevalent in the neighborhood or indeed in the whole police district of Calcutta. It was proved that, as usually in such cases, the dwellers around the tank used it for bathing and drew thence their drinking water. It was also elicited that the linen of the first fatal case befouled with cholera dejections had been washed in the tank. The conclusion of the German Imperial commission in regard to cholera in Holland is as follows:—1. Holland is highly affected by the cholera at every epidemic, chiefly in those parts where they drink water directly from the rivers or canals or from ground saturated with sewage. 2. In places where rain water is generally drunk the disease is far less violent. 3. Places where there is no other drinkable water but rain water are not affected by the epidemic—the single cases occurring there are imported. 4. When places affected by the cholera were supplied with pure water instead of the vitiated water, the disease disappeared.

Dr. Pettenkofer, of Munich, Germany, lays great stress on the condition of the soil as a factor in promoting epidemics of cholera.

His views are embodied in a lengthy article in the *Lancet*. He finds that relatively low-lying sites are most favorable to the production of cholera epidemics, and hilly and mountainous regions are less frequently attacked, and where the soil is compact and only slightly permeable to water and air the development of cholera is much hindered, and that a porous soil is necessary for the production of a cholera epidemic; loamy sand and soils consisting of alluvial deposits are especially favorable. He explained the prevalence of cholera in Malta, which is a rocky island,

by the fact that the rock is not dense like that ordinarily observed but is porous, one-third of its volume consisting of air-containing pores. It is so soft that it can be cut and sawn like wood; all kinds of carved work are made from it, and tiles for floors, and he found that English sailors used vessels cut out of this rock for filtering their drinking water. These facts explained to him why cholera had become epidemic on what was supposed to be an unfavorable rocky site. But he finds that simply a porous soil is not sufficient to lead to a cholera epidemic; these pores must contain organic matter and water. Here we observe all the conditions ne cessary for the growth of bacteria—another proof of the dependence of cholera upon a germ. The more abundant the organic matter the better will the bacteria thrive, the principle being the same with these lowest forms of plants as we see illustrated by the farmer in manuring the soil to promote the growth of the higher plants. He continues: The germs of putrefaction and fermentation abound in the free atmosphere, but they only grow and multiply when they find suitable food. The hygienic uses of cleanliness here find their explanation and scientific foundation. The refuse from houses dissolved or suspended in water forms an excellent nutritive material for the lowest organisms which are so hurtful to us. Where all refuse organic matter is speedily removed from about our dwellings or cities, and a good system of drainage obtained, with a plentiful supply of water, the conditions favorable to the development of bacteria, whether fermentative or pathogenic, are removed. Where there is no moisture their development will not proceed, so that a dry soil is as unfavorable to the growth of bacteria as we all know it is to higher plants. On the other hand, too much water, he thinks, may not favor its rapid propagation in the soil, for the cholera bacteria being an aerobe requiring oxygen could not obtain it when the pores of the soil were completely filled with water. Bearing on this point, he points to the recent discovery of Klebs and Tommasi Crudeli of the micro-organism of malarial fever (bacillus malaria), which flourishes only in a moist soil containing air. He thinks cholera prevails chiefly when the subsoil water is low, and least so when it comes near the surface. The favorable conditions here indicated are found where dry hot weather follows a very wet period Most of Dr. Pettenkofer's researches sustain the parasitic theory of cholera; but few agree with him that cholera can only occur where these conditions of soil are all present; such conditions doubtless are best adapted for th growth of bacteria; but cholera has prevailed where they did not obtain, and just as often has not spread where every favorable condition for its growth and dissemination was apparently present. But these variations in the action of the cholera poison may be partially explained by the fact already mentioned, that the cholera bacteria may begin and develope where all the conditions are favorable, but other bacteria, such as those of putrefaction and fermentation, may destroy them, and this may happen at any time during an epidemic. Lebert, (the writer of the article on cholera in Zeimmsen's Cyclopædia of Medicine), believes that the bacteria of decomposition destroy the germs

of cholera. On this subject he said: "A specific germ, a favorable medium of development, sufficient contact with the human organism, only slight and temporary development of its protomycetes, destructive of cholera germs, these are the fundamental conditions for the development and diffusion of cholera to any great extent, and every perturbation, every solution of continuity in the chain of these factors of development may prevent or lessen its destructive action." In the same manner is explained the fact observed in some epidemics that cholera has superceded in a great measure other infectious diseases which had previously been prevalent. "The fact that in every epidemic there are individual centres where cholera prevails with intensity, while it is relatively very light in the nearest vicinity, as in the next house or across the street, is a positive proof how much local and localized influences may affect the development of the germs, and thus the disease itself; they must have the most favorable conditions for their full, vigorous development." "Nothing acts exclusively in the development of cholera, the only indispensable factor is the cholera germ; this acts in every case from the lightest to the most severe, at every p[illegible], in every epidemic, in every land of the earth, and yet its action, t[illegible]aries in extreme degrees. In many cases it causes but a light cholerine, while in others it may be fatal in a few hours, the difference depending on the numbers in which it has entered, and on the favorable or unfavorable conditions it encounters in different individuals."

The cholera poison may be carried to considerable distances by clothing and other articles exposed to the contagion which is contained in the intestinal excretions, and they may retain their infectious quality for a variable time; many instances are on record where these have conveyed the contagion to others, even after crossing the ocean. It is also recorded that at Marseilles some of the clerks who handled the outgoing mails were attacked, but of those who sorted the mails coming from the East where the disease prevailed one after another suffered from cholera. That cholera is directly communicable from the affected to the well (contagious) is a fact thoroughly established, although denied by some. The possibility of a doubt on this point depends on the fact that the vitality of the germs in air is slight compared with their condition in water, and as they must reach the alimentary canal in order to infect, most persons who simply come near a cholera patient are not attacked with the disease.

Our attention has already been drawn to the fact that individual susceptibility to cholera varies. It seems to attack the strong as well as the weak, but those whose systems are debilitated by previous disease, improper living, dissipation, drunkenness, or any influences exhausting the vital organs, are better subjects for the disease, and are less liable to recover. A difference of opinion seems to exist in regard to the influence of intemperance; because it usually prevails among those whose surroundings are marked by crowding, poverty, filth, personal neglect, etc., it is thought to predispose to cholera; but Stille says: "Apart from the brutish mode of living of drunkards, there is nothing to show that

they are more liable to cholera than the most abstemious of water-drinkers. On the contrary, it is notorious that during cholera epidemics drunkards in the better classes of society enjoy a certain degree of immunity from the disease, which is easy to explain on the ground that they imbibe but little water, which is the main channel through which the infectious principle of the disease is spread." But it must be accepted as an undoubted fact, and one supported by various eminent authorities, that drunkards are less likely to recover from the disease than others.

The male sex is said to be more liable to cholera than the female, but in the latter the mortality is greater. Young infants are not often attacked, and children less frequently than adults. The greatest number of deaths occurs between the ages of 20 and 30; although later in life the susceptibility is somewhat less the mortality is greater.

The average duration of an epidemic is from 2 to 4 months, but the variation in this respect is as marked as that of the intensity of cholera in different places and at different times. When cholera appears in a place it does not spread in a uniform manner, but according as the germs are spread by water, infected clothing or vessels, and finds a lodging in the ground or drinking water, in the moisture of walls, in the damp, heavy, musty air of unventilated rooms, in sewers and their emanations, &c., so will we find particular localities, blocks of buildings, streets or individual houses affected.

The period of incubation, or the interval between the time of infection and the onset of the disease, varies, but is on the average from two to three days. It may be only twelve hours or extend over a week. This would indicate the length of time required to detain a vessel suspected of importing cholera. If no case occurred in a week it would would not likely occur after.

One attack of cholera does not always protect from another. There are numerous cases on record where persons have had the disease twice.

When cholera invades a place, generally a few cases first appear; then after two or three days the epidemic sets in severely, or its advent may have been preceded for months, as in England in 1849, by diarrhœa. Its disappearance may be sudden, especially after sudden atmospheric changes but it usually declines gradually, and as a rule during its disappearance the mortality is less. More of the attacked recover than at the commencement of the epidemic. It may leave a place for a time and again return to it, and with equal or greater severity.

A typical epidemic, where the disease begins with a few cases, and then bursts forth with widespread intensity, and its gradual decline with diminished mortality, is quite in accordance with the life history of bacteria. The poison from the first cases finding a favorable soil rapidly multiplies, there being abundance of suitable nutriment. Later, in a few weeks, the continuous multiplication gradually exhausts the germs, and fewer are affected by them, and when attacked have greater chances of recovery. This difference in vitality

of the germs may also explain the diverse mortality in different epidemics.

The prevalance of other zymotic or infectious diseases which has been observed during years in which cholera was epidemic can only be accounted for on the germ theory; for, although the various disease-producing germs may have distinct actions on the system, they mostly thrive on the same kind of nutriment.

The general average mortality from cholera is 50 per cent. of those attacked, but in different epidemics it has ranged from 10 to 90 per cent.

There is no uniform proportion between the extent and mortality of cholera epidemics; some of limited extent have been proportionately the most destructive. As a rule, the laboring classes suffer most from its ravages.

DR. KOCH'S DISCOVERY OF THE COMMA BACILLUS OF CHOLERA.

From what has been stated we may observe that the germ theory best explains the nature and cause of cholera. Most authorities on this subject favor this view, but until within the last year the proof was wanting, and even yet some are not convinced. All believers in the germ theory were filled with hope when it was learned that Dr. Koch, chief of the German Scientific commission for the investigation of cholera, had gone to Calcutta to investigate the supposed cholera germ. Dr. Koch may be regarded as the most celebrated and competent bacteriologist living. He it was who in 1882 made the brilliant medical discovery of the bacterial parasite, the presence of which gives rise to that dread disease, tuberculosis or consumption, the announcement of which aroused such interest and enthusiasm in the medical world. In his report of January, 1884, he announced the discovery of a bacillus occurring invariably in the cholera discharges and intestinal contents, and also in the intestinal mucous membrane, but not in the stomach. He could not find this bacillus in any other affections, even in such allied ailments as diarrhœa, dysentery, etc. He found the same bacilli in a water tank, which was supposed to have spread the disease to the inhabitants around it, 17 of whom had died out of 200. He examined the water of other tanks in the district but failed to discover the bacillus in any but the one around which cholera prevailed. These tanks supply the water used for bathing, drinking and laundry purposes, and he found that the linen of the first case had been washed in this tank. The bacilli were curved like commas, and were sometimes joined together, appearing like the letter S, hence he thinks they may be spirilli rather than bacilli. They are very mobile, and occur in colonies of wavy masses. By cultivating them he learned that they thrive best at a temperature between 30° C. (86° F.) and 40° C. (104° F.), but their growth is not drevented by lower temperatures until 17° C. or 16° C. (60 4-5° F.) is reached. He exposed them to a temperature of 10° C., thus freezing them, but they would afterwards grow in gelatine. They re-

quired oxyen for their growth, but being deprived of it did not kill them. They grew with exceptional ra idity, the growth quickly attaining its maximum and after a brief stationary period as quickly terminating. They grew luxuriantly on linen or soil moistened with choleraic discharges quickly outnumbering all other bacteria present, but after 2 or 3 days the bacteria of putrefaction would replace them. An acid condition of the medium in which they were cultivated checks their growth.

In regard to the influence of drugs upon them he found that 1 part of iodine in 40,000 had no effect on their growth, 1 part of alcohol in 10 was the least proportion that had any influence upon them, 2 per cent. solutions of sulphate of iron which will arrest putrefaction did not affect the comma bacillus, nor did 2 per cent. solution of common salt, stronger solutions than these could not well be used for internal administration. Alum 1 in 100 prevents their growth, and so does camphor 1 in 300, carbolic acid 1 in 2,500, quinine 1 in 5,000, and corrosive sublimate 1 in 100,000. But these proportions place their administration beyond the range of practical therapeutics. An important point is the fact that drying the bacilli for an hour or so readily destroys them. Hence he doubts if they ever pass into a resting state. He cultivated them for six weeks and no spores were formed, but they may yet be discovered. Infected clothing or earth, when subjected to drying for 24 hours and upwards, were completely disinfected.

Koch had not been able to produce cholera in animals by inoculating with the comma bacillus, but two Swiss physicians, Drs. Reitsch and Nicati, at Marseilles, last year succeeded in doing so by placing the virus in the intestines below the stomach, and Dr. Koch subsequently confirmed these experiments, guinea pigs dying with symptoms of cholera in 12 hours after being inoculated with an attenuated virus. The bacilli are usually destroyed in the stomach, but when this organ is deranged and the food partly digested, the bacilli may pass, to the intestines, where they immediately begin to multiply. The symptoms which follow are supposed to be caused by the action of a specific poisonous substance produced by the bacilli. The cells of the mucous membrane are destroyed and the watery portion of the blood is poured out at the seat of the irritation. The fact that the bacilli are soon destroyed by drying would favor the view that the poison of cholera is usually conveyed through fluids or damp clothing and not by the atmosphere. Dr. Koch says it is not proved and doubtless never has occurred, that cholera has been transmitted by letters. The rapid development and decline of the bacilli would seem to accord with the brevity of an attack of cholera and comparatively short duration of a cholera epidemic, and no spores being formed also accords with the fact that cholera does not reappear in the year following an epidemic. The invariable occurrence of the comma bacillus in connection with cholera suggests a means of at once recognizing its presence by an appeal to the microscope and the cultivation of the bacilli, and thus in doubtful cases valuable time might be gained for adopting measures towards checking the spread of the disease, and, if recognized in individuals, appropriate treatment.

might be employed in the earliest stages, when only, as a rule, it is likely to be successful. All medical health officers should be quite familiar with the use of the microscope.

Dr. Koch's discovery of the comma bacillus, and his conclusion strengthened by the results of subsequent investigation at Toulon and in Egypt, that it is the cause of cholera, has led to considerable controversy, and has during the past year agitated the scientific world more than any other subject. His opponents cite such alleged facts as the following in opposition to his views. Thus Drs. Finkler and Prior of Bonn and Klein and Gibes, London, claim to have discovered the comma bacillus in sporadic cholera, and the latter found it also in dysentery, phthisis, and in the mouth. Dr. Deneke, of the Hygienic Institute, Gottingen, has found a comma-shaped organism in stale cheese. W. D. Muhler discovered a bacillus in the saliva, which Dr. Lewis believes to be identical with Koch's bacillus. The reply to these objections by Dr. Koch, Mr. Watson Cheyne and Dr. Heron, London; Dr. Van Ermengen, Belgium, and other investigators, is that morphological criteria alone are not sufficient to show that the bacilli are identical. Their physiological characters must be similar. Under cultivation the mode of vegetation and the colonies, etc., of the above are quite different from the cholera bacillus, hence they are distinct species.

Dr. Emmerich of Munich, who was sent to Italy by the Bavarian Government, supported by Buchner, claims to have discovered a bacillus in the blood and internal organs, which he believes to be the true cholera bacillus; and M. Strauss and Roux, of the French cholera commission, who, in their investigations at Toulon last year found the comma bacillus, —the result of their researches in the main coinciding with those of Dr. Koch—also claimed to have discovered a bacillus in the blood. But Dr. Koch points out that in healthy blood, besides red and white corpuscles, there exists in varying numbers small, roundish, pale elements, the so-called "blood plates"; in some febrile diseases they are greatly increased, and are often mistaken for bacteria. Ignorance of this fact led the French commission to conclude as they did.

To the fact—so confirmatory of Koch's doctrines—that the comma bacillus has been found by all investigators, whether in Europe, Asia or Africa, in every case of cholera examined, may be added another, tending in the same direction, viz., the discovery by Dr. Bristowe of a curved bacillus in cholera, in 1866. The cessation of the prevailing epidemic rendered further study of the germ impossible; no deductions were made, and the circumstance was forgotten. He had approached the borderland of a great discovery. For forty years scientific men have been making search after the supposed germ that gives rise to cholera. Bohm found cryptocamic bodies in 1838, Brittan and Swayne in 1849, and organisms were discovered by Bouchet and Davaine, and by Paccini in 1856. McCarthy and Dove found motile elements and researches have also been made in this direction by Haller, Kolb and Tholme, Debarry, Cohn, Cunningham and Lewis. Dr. J. C. Peters of New York, states in the

Medical Record that Dr. Dundas Thompson, and Dr. Hassal, discovered vibrios in 1854, and in 1872 Dr. Nedwetsky found bacteria, in the rice-water discharges; and in experimenting with them found that out of a great many drugs only tannin, chlorine water, and dilute sulphuric, hydrochloric and nitric acids were capable of destroying them. At the meeting of the Royal Medical and Chirurgical Society of London, held on March 24th and 31st last, cholera was the subject for debate. Drs. Klein and Gibbes, of the English cholera commission, who were sent to India to study the relation of the comma bacillus to cholera, arrived at conclusions mostly adverse to those of Koch. Yet they do not deny having found Koch's bacillus in all cases examined, but they are inclined to look upon them as a post-mortem occurrence, and they could not produce any effect by inoculation, but Koch himself, the ablest experimenter living, failed also in his first attempts. Dr. Klein held views previously in regard to cholera which he could not well maintain if Koch's conclusions are correct, hence he was undoubtedly somewhat prejudiced when entering upon these investigations. He claimed also to have discovered a straight bacillus in greater abundance than the curved, and these are observed in the specimens I received recently from Germany through Mr. T. Heinrich, Baltimore, which you are invited to examine this evening. Mr. Watson Cheyne, in reply, said that much misconception appears to have arisen from the adoption of the phrase "comma shaped," for it appears that the curving is but an incident of one stage in the life of the bacillus. It is at one time straight, then curved, and sometimes spiral, but, whatever its morphological change is, it exhibits invariably the same reactions and characters on cultivation. Mr. Macnamara, and eminent authority on cholera, agreed with Mr. Cheyne's statement, that what was known of the properties of cholera contagim 20 years ago corresponds with those now recognized as belonging to the comma bacillus, and he has found in practice that the most appropriate treament for cholera is that which is most obnoxious to the bacillus. Hence he accepts fully Koch's conclusions. It is generally conceded that the results obtained by the investigations of the English cholera commission have, on the whole, rather confirmed Koch's views than otherwise, and the crucial test to which his doctrine has been subjected in the keen criticisms of this body of pre-eminently scientific physicians has not in the least weakened the position assumed by him in its promulgation.

The value of this discovery is beyond estimation. For centuries vague and diverse views have prevailed regarding the cause of cholera, and the means adopted for staying its ravages have been as varied as the theories entertained. No satisfactory solution of the problem had hitherto been made, and it has remained for the acute intellect of the year 1884 to reveal the pernicious offender, and we may hope that further investigations will in the near future point out the best means of combating its destructive effects.

From the last journals we learn that several physicians in Barcelona inoculated themselves with an attenuated cholera virus,

which gave rise to a mild affection; a repetition of the experiment 9 days after had no effect. Rabbits inoculated were not affected subsequently by double the dose which was found to be fatal to unprotected individuals. Later in Valencia Dr Ferran has inoculated over 6000 persons, some having died, the Spanish Government has appointed a commission of enquiry and prohibited further inoculations. As the comma bacillus has not been discovered in the blood, it will be interesting to learn the method adopted by him and what means of protection it has afforded. The principle of securing immunity against infectious disease by innoculation with an attenuated virus (exemplified in vaccination) may yet prove to be one of general application, but whether its adoption could become practicable in the absence of less effective means is among the problems of the future.

THE PREVENTION OF CHOLERA.

As cholera is peculiar to India, always being imported when occurring elsewhere, it follows that measures for its prevention will be of a twofold nature. 1st, Measures to prevent its importation, or, in the event of its reaching our shores or borders, to recognize it there and confine it to the point of entrance; this duty obviously devolves upon the Dominion Government, and is accomplished chiefly by means indicated in the quarantine regulations. 2nd, Local measures throughout the Dominion, which include the application of all those principles of hygiene which are known to promote a good sanitary condition. Should cholera appear in this country again it will invade us either directly through the shipping which comes to our shores or indirectly from the United States. No effectual means could be adopted here to intercept the disease at the boundary line between this country and the neighboring Republic.

Land quarantine, sanitary cordons, lazarettos, &c., are impracticable preventative measures, and where adopted have usually failed to accomplish their purpose, often adding to the danger instead of lessening it.

At the congested points where they are being enforced the detention and crowding together of a miscellaneous mass of humanity presents a condition exceedingly favorable for the spread of infectious diseases, and again when these measures are depended on the more important improvement of the local sanitary condition is often neglected. For protection, therefore, along our southern borders, we must depend on the United States quarantine regulations, and in like manner the adjoining Union and this Dominion may be shielded from the scourge by the efficient carrying out of the quarantine regulations at the quarantine stations at Halifax, St. Johns, Pictou, Sydney, Charlottetown, Victoria and Rimouski, and Grosse Isle, Quebec.

If every vessel arriving from infected countries, or other place, is carefully inspected; and in the event of any cases of cholera or suspicious cases of intestinal troubles occurring, the immediate removal of them to places in the vicinity, where they can be properly cared for, be effected, until free from risk of conveying infection, and if those vessels are thoroughly cleansed, disinfected and aired, before being admitted to pratique, and if such infected vessels with their passengers and all on board

who are not sick be detained in quarantine for one week, and a thorough cleansing of the person, clothing and baggage be carried out, we should not be visited with cholera this year beyond the quarantine stations. The Hon. Mr. Pope stated recently that the Dominion Government had prohibited the importation of rags, and that regulations for precautionary measures against the introduction of cholera or other epidemic diseases had been issued to all customs and quarantine officers.

All mail steamers coming up the St. Lawrence are inspected at Rimouski and all others at Grosse Isle. Dr. Leale, in an article on cholera in the New York *Medical Journal*, believes quarantine, if absolutely perfect, will surely prevent cholera in America. Dr. J. C. Peters, in a paper read before the Medical Society of the County of New York, on Feb. 23rd last, in speaking of the advantages of effective quarantine, mentioned Denmark as an illustration, which had always escaped cholera, except on one occasion, when it raised its quarantine, and also Greece, which did not have a cholera epidemic until the quarantine was forced by the French and English during the Crimean war. Dr. Loomis, of New York, believes that if the conditions favorable to the growth of the cholera germ are carefully guarded against, and sufficiently strict quarantine maintained, cholera may be prevented. Dr. Sayre thinks that the Government will be responsible for permitting the disease to come to America; a rigid proper quarantine universally adopted by the general government, in combination with the British provinces, would, in his opinion, prevent it. Dr. Stille thinks that "if these measures sometimes succeed in arresting the progress of cholera, and if they always, when honestly executed, lessen the number of channels through which the infection can be conveyed, and thereby reduce to a minimum its fatal effects, they ought to be maintained and perfected and not decried or abolished." In Europe, land quarantine as a preventative measure is being generally discarded. The Academy of Medicine, France, decided against it last year. It was condemned also by the International Medical Congress of 1874, and by the German Imperial Cholera commission, 1880. In England, quarantine is replaced by a system of inspection which involves the examination of all and the isolation of the sick; improvement of the local sanitary condition is especially insisted on. According to the London *Lancet* quarantine is like putting up an iron grating to keep out mosquitoes, and it only prevents the employment of better and more efficacious means. The chief objections made to quarantine is in regard to the interference with commercial relations and travel, and this is very great in such densely-populated countries as England and the various European nations. Another objection that it is seldom successful, is doubtless well founded in those countries, and its uselessness will be found to obtain in proportion to the density of the population and the greater number of points of communication between infected and non-infected districts.

The rapid transit of vessels across the Atlantic increases considerably the possibility of importing the infection of cholera here. It is a remarkable fact bearing on this point that in the begin-

ning of the present century, when vessels first sailed between England and India around the Cape of Good Hope, that they never conveyed the disease from its seat in the East, and the want of facilities for rapid travel doubtless explains why cholera was confined for centuries to Asia, not being known in Europe until 1830, at a time when communication between it and Asia by land and water was much more rapid. In this country we have chiefly to do with ocean quarantine, in vogue in most countries, and vigilance is required at but a few points. Hence thoroughness in carrying out the quarantine regulations at the landing points, especially at Grosse Isle, should, here at least, constitute reliable protective measures.

It is to be hoped that the Bill concerning public health and vital statistics now before the Provincial Government will be adopted at this session. It reflects unfavorably on our province that in such important matters we should be so far behind other places. We would do well to copy a leaf from Ontario in regard to this subject.

A Provincial Board of Health with a good sanitary code, are absolutely necessary in order to secure a proper carrying out in the various cities, towns and villages, of the requisite sanitary regulations, which will enable them to cope with an invasion of cholera or other epidemic. It is very important that a general knowledge of the nature of cholera should obtain among those upon whom devolves the great responsibility of enforcing the quarantine regulations and supervising local preventative measures, in order that they may meet the foe intelligently; and among the people at large an acquaintance with the nature of the disease and the best local means for staying its progress will lead them to more readily comply with any regulations which the sanitary authorities may devise. It would add to the safety of Montreal and the country generally if, in addition, a rigid inspection of all immigrants and their baggage, &c., arriving in the city, was provided for.

The utility of quarantine would be considerably enhanced if a proper system of medical service on the ocean steamers was in vogue. The importance of this subject is being recognized by authorities on both sides of the Atlantic. In 1883 the Parliamentary Committee of the British Medical Association memorialized the Board of Trade on the subject, and in the same year a Committee of the American Medical Association drafted a Bill tending to reform in this direction, which is now awaiting the approval of Congress. At present no organized system exists. Medical officers are appointed by the shipowners, without regard to any standard of qualification, and the remuneration is such that it cannot command the services of competent men, and they have no power without the consent of their employers to improve the sanitary condition of vessels or adopt precautions which would lessen the possibility of conveying infectious diseases. As the retention of their positions depends on their acting only in harmony with the interests of the company they serve, many essential sanitary precautions are neglected, and thus it frequently happens that quarantine officials receive misleading reports, and hindrances are

opposed to the inspecting officers, and their vigilance thwarted. The remedy proposed is the appointment of a permanent government *marine medical service*, with proper remuneration and the usual privileges in regard to promotions, superannuations, &c., and with authority to carefully guard the interests of the public. It is easy to appreciate the advantages that would accrue if the medical officers on ships were independent of the owners and acting in entire accordance with the quarantine officials on either side of the Atlantic. The possibility of conveying cholera or other infectious disease would be reduced to a minimum.

LOCAL MEASURES.

A good water supply, free from all possibility of contamination from cesspools or other source of organic impurities, is of paramount importance. We are fortunate in Montreal in this respect, and the recent appropriation by the city council for an additional engine will greatly increase the capacity of the water works, and enable the health committee to secure frequent flushing of the drains, so necessary here in view of the fact that all sewerage is emptied into drains, which are open at every street corner, thus permitting the escape of foul and noxious gases, which inevitably arise from the decomposing matter as it slowly wends its way to the river. A better system would be one in which all solid organic refuse would be kept from the sewers, removed frequently before decomposition sets in, and immediately destroyed by burning, and where the liquid sewerage and ground drainage is disposed of through distinct channels. The material of the conducting pipes for the former should be impermeable to fluids, and they should be open only at the summit of the ventilating tubes above the tops of the houses and at the point where the sewerage makes its exit.

It is to be hoped, also, that the water-closet system may soon be introduced into every house and the privy vaults entirely abolished. The degree to which the 10,000 or more existing in this city, owing to foul and dangerous decomposition, taint the air and soil, is sufficient to neutralize all the advantages we have in our plentiful water supply and the most careful work of scavengers.

The adoption by the council of the new incinerating process for the destruction of refuse is a move in the right direction, and if, in addition, the privy vaults could be all emptied, disinfected and filled up, the system, faithfully carried out, would improve our sanitary condition. Where water closets are not constructed a system of earth or ash closet, the receptacles in which should be frequently emptied, would be an efficient substitute combined with disinfection. The natural features of our city are favorable for good drainage, and we have an excellent system of drains of the kind, but it is not supplemented in many instances by proper connection with the houses. There is a woful amount of imperfect plumbing in otherwise desirable houses. This is one of the most important matters in a health point of view and should be seen after by every householder at once. If any defect exists

in the drain pipes the house becomes part of the sewer system, and if, in addition, ventilators are kept closed and the free admission of fresh air prevented we simply invite disease to our homes.

May this not to some extent account for the prevalence of zymotic diseases which we have experienced this winter; in the sleeping hours, when the vitality is lowest and ventilation is generally thought not to be necessary, the noxious gases, possibly conveying almost invisible germs, come silently in through the unfastened door more stealthy than the midnight robber, and bound on a more-to-be-dreaded errand, and secures its victims one after another, either directly or by so lowering the vitality that the susceptibility to disease is abnormally increased. Perfect drain pipes properly trapped in all public and private buildings, and frequent flushing of the sewers will, to a great extent, keep the breathing air free from contamination. Then free ventilation at all times. The entire and frequent removal of all organic refuse matter from streets, lanes and yards and wherever found, especially in the early spring before the warm season sets in, when everything is favorable for the growth of bacteria, and the observance of strict habits of cleanliness by the people generally will go far towards keeping cholera and other infectious and contagious diseases from our midst.

It is a mistake to cover yards with boards or planks. They permit organic matter to collect beneath them, where it cannot be reached for removal, and when the hot weather sets in, foul odors result from the putrefactive changes which take place. All such covering, and especially when in a rotten condition, should be removed, and the yards levelled up with macadam and sand, or ashes and cinders, &c.

A number of district physicians should be appointed throughout the city to aid the health officials in maintaining a good sanitary condition and otherwise, and in case of an epidemic to assist in caring for the affected among the poor, who chiefly suffer. They each might have charge of a local dispensary, where the poor could get the necessary remedies, for it cannot be too strongly insisted upon that treatment avails but little as a rule, except in the early stages, and during such times the slightest intestinal derangement should receive prompt attention. This advice is more likely not to be heeded by the poor than others, and thus local charitable dispensaries might be the means of saving many lives.

A system of house-to-house inspection should be inaugurated, and the people urged to cleanse their houses as well as yards, sheds, &c. There are many places in the city where the lowest classes of the poor are crowded together in small, badly-ventilated houses, which are seldom if ever favored with water and the scrubbing brush, and where a number of these hovels surround back yards with a common privy vault, and one or more wooden tubes to convey sewage to the street drain; these places, if not looked after, will prove veritable hot-beds for cholera bacilli, should they be implanted here.

All cellars, outhouses, stables, &c., should be kept scrupulously clean and a liberal coating of whitewash applied. Stables should have con-

crete or asphalt floors; this would prevent the escape of all fluid excreta, which soon saturates the soil around them if permitted to escape; ground thus saturated soon becomes the seat of dangerous putrefactive decomposition, and would afford an excellent medium for the development of cholera bacilli. Manure should be placed in close boxes instead of on the ground, and removed frequently. Houses with damp walls are very unhealthy, hence, if built in low-lying places, thorough, deep drainage is required. As brick walls are pervious to air and draw up water by capillary attraction, a high stone foundation with a layer of asphalt between it and the brick, in addition to good drainage, will enable them to be kept dry. Brick walls when dry permit an interchange of the air within with that outside. This desirable condition is prevented if they are soaked with water, and thus the air within is damp and usually foul, thus lowering the vitality of the inmates, predisposing to disease, besides being a favorable site for germs to flourish. All low-lying places where surface water can collect should be well drained.

In yards the growing of plants tends to remove superfluous and foul moisture. One or more maple or elm trees may be planted: sunflowers especially absorb large quantities of water; climbing plants and any with abundant foliage will be found to have a corresponding amount of absorbing rootlets. Arranged so as not to obstruct the free entrance of sunlight, an otherwise unwholesome place may be converted into one of attractiveness and free from danger to health, becoming at the same time a source of pleasure and edification. The eucalyptus tree, which absorbs immense quantities of water, has in Italy and other countries made healthy large malarious districts.

There is one nuisance in this city which should be kept under the close surveillance of the health authorities—that is, the trade in second-hand clothing. No doubt infected clothes are often sent to the dealers in these articles, and thus become the means of spreading disease. It would be a safeguard if the vendors of such wares were compelled to cleanse and disinfect, by heat or otherwise, all articles of the kind previous to their being offered for sale; and this would apply also to the second-hand clothing and house furnishings sold at the auction rooms. Suitable laundries or disinfecting houses should be provided by the board of health.

It is hardly necessary here to speak of the danger of permitting slaughter-houses, soap, candle and glue factories, tanneries, &c., to exist within the precincts of the city.

A thorough inspection of meat, milk and all articles of diet and drink, so that only what is pure and wholesome may be offered for consumption, is of primary importance.

It must be borne in mind that if we should be so fortunate as to escape a visit from cholera any precautions taken and expense incurred in the direction of improving the sanitary condition of the populous centres or dwellings will not be unfruitful efforts, for these are the sanitary means by which at all times a high standard of health can be main-

tained, and are necessary to prevent the spread of other diseases which are almost constantly with us, the mortality from which far exceeds that caused by the comparatively rare visitations of cholera.

Should any suspicious cases be observed the health authorities should at once be notified. Then a microscopic examination of the discharges and cultivation of the bacilli would demonstrate the presence or absence of the specific cholera bacillus, and thus a mild case (the type which, from not being recognized, often introduces and disseminates the disease) of the affection might be detected. Should investigation reveal the presence of the scourge then every means should be adopted to confine it to its primary seat, by isolating the first cases, either by placing them in the uppermost room of the house—as far away from other inmates as possible—or in temporary hospitals which should be placed in readiness if an epidemic is threatened, with proper arrangements for the speedy removal of cases to them and skilled attendants secured. The room or ward should be large, with facilities for good ventilation, and carpets, contents of drawers and clothes presses, and everything but what is required for the patient, removed. It would be well to use only inexpensive mattresses, which should be burned subsequently, and iron bedsteads would be preferable. Hanging sheets impregnated with disinfectant solution over the door is only of limited use. Then as the dejecta can spread the disease they should not be placed in water closets and thus allowed to infect the drains, or into privy vaults, streams, or other places from which they may gain entrance to wells or other source of drinking water. Before removal from the sick room they should be disinfected by some reliable germicide, such as corrosive sublimate, or, better still, receive them in sawdust or cloths, and burn immediately.

In regard to disinfectants Koch's experiments indicate, which are likely to be of use in cholera, many of the so-called disinfectants have but little influence on the growth of disease germs, although they may arrest the fermentative changes of putrefaction. Heat is the best of all disinfectants, and as comma bacilli are killed by drying, dry heat would seem to be the most efficacious means for destroying cholera virus. Hence all soiled articles of little worth, rags, remnants of food, &c., should be burned. In hospitals and quarantine stations the erection of furnaces or crematories, or large iron boxes, which could, with superheated steam, be brought to a high temperature, would be a safe, sure and inexpensive method for disinfecting all articles of clothing, baggage, dishes, basins, drinking vessels, &c. Dr. O. W. Wight, of Detroit, recommends superheated dry steam as the best means for disinfecting ships. The boiling point of water will destroy all developed bacteria, but spores require a temperature of 240 ° to 300 ° Fah. The bacilli of cholera would be surely destroyed by exposure for an hour to a temperature of 240 ° Fah., and washable clothing, &c., may be purified even by boiling for an hour or two. In the Hospital St. Louis, at Paris, last year, infected clothing was boiled under a pressure much higher than the atmosphere.

Among chemical preparations the following are the most reliable:

Bichloride of mercury or corrosive sublimate is one of the best, (Miquel has shown recently that the biniodide of mercury is three times as potent), one part dissolved in a thousand of water, is the most reliable disinfectant solution now employed, but being an extremely powerful poison it must be used with care. Dr. Leale, president of the New York County Medical Association, considers alum solution, 1 part in 50 of water, one of the best disinfectants; it does not stain and rarely affects dyed fabrics. *Thymol Water* is recommended by the Illinois State board of health. A tablespoonful of spirits of thymol in half a gallon of water. Spirit of thymol contains an ounce of thymol in 3 of alcohol. It is somewhat expensive. *Chloride of Zinc*, an ounce to a gallon of water, is a useful antiseptic, or made with sulphate of zinc 4 oz, common salt 2 oz, and 1 gallon of water. Carbolic acid and resorcin 1 in 20 of water, a saturated solution of boric acid, hydrochloric acid 1 to 20 of water, and acetic acid or vinegar are serviceable disinfectants. Chloride of lime cleanses and deodorizes very effectually as do also the solutions of chlorinated lime and soda; charcoal, gypsum and quicklime are suitable deodorizers for sprinkling in damp places; cellars, yards, outhouses, privies, gutters, &c., copperas 6 lbs. to a pailful water also arrests putrefactive changes. Chlorine as well as bromine and the chlorides act only in the presence of water. They combine with hydrogen and set free active oxygen or ozone, which is an efficient disinfectant and deodorizer, constituting a portion of the normal atmosphere. Their affinity for hydrogen enables them to decompose fetid gases, such as sulphuretted hydrogen. Chlorine gas may be produced by mixing in a glazed dish 1 part peroxide of manganese, 2 of sulphuric acid, 3 of common salt, and 2 of water; placing on a warm stove favors its elimination.

Fresh air and sunlight with cleanliness are said to be the best of all disinfectants, and the chemical disinfectants and deodorizers can only rank as adjuncts, secondary to them and heat. Hence, it is very important that thorough ventilation of the rooms occupied by cholera patients be secured both day and night. If the weather should be cool a grate fire or the heat of a small stove will promote free change of air. This is not only necessary for the welfare of the patient, but also in the interest of the medical attendant and nurses, who alone should be allowed to enter the apartment. There is not much risk in attending on such cases if proper precautions are observed.

Besides good ventilation, which prevents the air from getting foul and heavy and thus favorable for the multiplication of bacilli, extreme cleanliness must prevail. The hands of attendants should be frequently washed in hot water with carbolic acid soap, or in hot antiseptic solutions, such as those of alum, thymol or carbolic acid. Towels used for wiping the hands should not be applied to the face. Avoid touching the lips or nose with the hands or handkerchiefs, and put no food or drink into the mouth while in the sick room. All dishes, drinking cups, &c., used by the patient should be cleansed in boiling water, and the discharges, if not received in sawdust and burned, should be received in bed-pans

containing a solution of corrosive sublimate. If the floor requires sweeping sprinkle sawdust saturated with a disinfectant solution over it, or wet sand, and burn the sweepings. Dust with a moistened cloth and burn after using. A tub should be placed in the room containing a quantity of any of the antiseptic solutions mentioned (those of mercury, alum, chloride of zinc, carbolic acid, or thymol are suitable), into which should be put all soiled bed-linen, clothing, etc. After soaking for 24 hours they should be boiled, then washed, and allowed to dry out doors exposed to sunlight. All food brought into the room and unused should be burnt. Sinks, water closets, etc., should be kept scrupulously clean, well-aired and disinfected Nurses should, if they have to leave the apartment, change their garments (which should not be of wool), and disinfect hands, face and hair.

During the prevalence of an epidemic all water-closets on steamboats, at railway depots, hotels, etc., should be cleansed and disinfectants used at least daily. Pour in a quart of any of the solutions mentioned each time they are used, after free flushing. Whenever a closet is used the water should be allowed to run for at least a minute. There should be a free flow of water from the flush pipe.

If the patient recovers or death takes place thorough cleansing and disinfection of the apartment must be effected. Chlorine, nitrous acid and sulphurous acid gases are the best disinfectant agents for fumigation. The latter, although the least potent, is more easily managed. It is a disinfectant by means of its affinity for oxygen, destroying organic matter to obtain it. It also decomposes sulphuretted hydrogen. All articles in the room which have not been disinfected by dry heat or boiling, or are too valuable to be destroyed, should be hung around the room or arranged so that they may be reached by the fumes. Every opening should be closed by pasting paper over them or otherwise. Then place on the hearth or stove, or on bricks in a wash tub containing a few inches of water, an iron vessel containing live coals; on these place the sulphur ($2\frac{1}{2}$ lbs. for every 1,000 cubic feet of space) or an equivalent quantity of a mixture containing 7 parts of flowers of sulphur, 2 of saltpetre and $\frac{1}{2}$ of camphor (Wight), this will burn by simply applying a match. The room must be kept closed for twenty-four hours, and then the windows and doors opened and kept so for a week. Walls should be re-tinted, or if papered it should be removed from them and the floors and wood work washed with some antiseptic solution. If death occurs the clothing in which the body is attired should be sprayed or sprinkled with the thymol solution, and the body wrapped in a sheet soaked in the corrosive sublimate solution and placed in an air-tight coffin. If these precautions are strictly attended to the disease should not spread.

If an epidemic prevails then still closer attention must be paid to every means for removing conditions of stagnancy and decomposition and for maintaining the dwelling in a wholesome condition, and strict habits of personal cleanliness observed. Milk and water should be boiled before using, aerated by being poured from one vessel to another and made

agreeable by pieces of ice. Properly filtered water may be drunk with safety. Dr. Leale recommends putting as much alum as can be held on a ten cent piece into two quarts of water, when after an hour all dangerous animal and vegetable growths will be found dead and settling to the bottom. His experience and personal observation at the alum springs of Europe lead him to conclude that no harm can result from its free use. All articles of diet should be thoroughly cooked and used as soon as removed from the cooking range, and unripe or decaying fruit and vegetables avoided. No other change need be made in the diet. Any wholesome food may be used. Meals should be taken at regular hours and not hurriedly. It would be better to use drinks chiefly after meals, as, while digestion is going on, bacilli are more likely to be destroyed by the gastric juice. Food of all kinds should be kept under gauze covers or otherwise from the reach of flies. They may convey the cholera virus on their limbs directly from infected places to articles of diet. As the cholera bacilli do not thrive well in acid solutions, it has been suggested that drinks containing mineral acids be used frequently during an epidemic, such as may be made with dilute sulphuric, hydrochloric or phosphoric acids, a half teaspoonful of any of these in a tumblerful of water. The latter combined with phosphates would be suitable, and at the same time act as a general tonic, so would acid preparations of iron. Wyeth's Liquor Acidi Phosphori Co., or Horsford's Acid Phosphate would be excellent preparations for this purpose. During an epidemic, public funerals and assemblies of all kinds should be prohibited, schools closed, and home worship substituted as much as possible for crowded church gatherings. And all unnecessary exposure to sources of infection should be avoided.

All should endeavor to maintain as high a degree of health as possible, and especial attention should be paid to the condition of the digestive organs, as sufferers from indigestion are especially liable to an attack of cholera. Those who are imprudent and careless and expose themselves to influences which depress the mental and physical powers, such as overfatigue, depressing emotion, drunkenness and excesses of all kinds are more likely to suffer than those who are more careful. All should have daily outdoor exercise and plenty of sleep. The daily use of the bath is an absolute necessity in order to ensure perfect health. It is also wisdom to keep the mind calm and free from over-anxiety or fear, and in no way can this courageous and confident attitude be so well attained as by possessing the consciousness that all necessary precautions have been observed. The wearing of a flannel abdominal bandage may be recommended to any who are especially liable to intestinal trouble. Do not trust to any quack nostrums for treatment. The qualified medical practitioner can alone deal effectually with this terrible disease, and modern medical science can do more now than in former years to rob this fell destroyer of its terrors and its victims.

Anyone suffering from diarrhœa of even the mildest type should without delay consult a physician. It would be well if, during an epidemic, each one was furnished by his physician with a quantity

of a suitable remedy, which he should carry on his person and use if there were symptoms of the disease. The time lost in attempting to reach a physician might in some cases be fatal to the sufferer.

Inoculation with an attenuated virus can scarcely yet be recommended as a preventative measure, but it may yet be shown that protection from the disease can be insured in this way. Recent reports from Valencia, Spain, where cholera is prevailing, inform us that a number of physicians there have been experimenting upon themselves with attenuated bacilli, and Dr. Forran has inoculated over 6000 people. Should later reports from this place and Barcelona demonstrate the utility of this measure a great boon will have been conferred on humanity: but the facts that the cholera bacillis have not been discovered in the blood (only in the intestinal canal) and that one attack of cholera does not always prevent from subsequent ones, are obstacles which loom up against any hope, anticipating protection from this scourge through such means.